TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during January, 1924*—Continued.

RELATIVE HUMIDITY (%).

Altitude, m. s. l. (m.)	Broken Arrow, Okla. (233 m.)		Drexel, Nebr. (396 m.)		Due West, S. C. (217 m.)		Ellendale, N. Dak. (444 m.)		Groesbeck, Tex. (141 m.)		Royal Center, Ind. (225 m.)	
	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 9-yr. mean.	Mean.	Departure from 3-yr. mean.	Mean.	Departure from 7-yr. mean.	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 6-yr. mean.
Surface	69	−1	88	+6	68	+1	80	−2	77	0	81	+2
250	69	−1	.....	.....	67	0	.....	.....	74	−1	80	+1
500	64	0	85	+6	63	0	79	−2	67	−5	73	−1
750	62	+2	78	+5	60	0	75	+1	63	−5	68	−1
1,000	59	+3	73	+6	58	0	72	+5	59	−3	63	−1
1,250	55	+3	68	+5	55	−2	68	+7	53	−4	58	−1
1,500	51	+3	65	+5	53	−3	66	+7	50	−4	57	+1
2,000	45	+2	64	+6	48	−3	66	+8	45	−4	59	+8
2,500	44	+3	60	+3	42	−6	68	+10	39	−7	57	+6
3,000	46	+6	62	+5	39	−7	68	+10	35	−8	58	+6
3,500	44	+5	61	+6	37	−9	64	+9	33	−8	62	+5
4,000	42	+6	59	+5	36	−10	65	+12	34	−4	.....	.....
4,500	41	+5	59	+5	.....	.....	69	+10	34	−3	.....	.....
5,000	43	+6	60	+6	.....	.....	69	+10	33	−3	.....	.....

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during January, 1924*—Continued.

VAPOR PRESSURE (mb.).

Altitude, m. s. l. (m.)	Broken Arrow, Okla. (233 m.)		Drexel, Nebr. (396 m.)		Due West, S. C. (217 m.)		Ellendale, N. Dak. (444 m.)		Groesbeck, Tex. (141 m.)		Royal Center, Ind. (225 m.)	
	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 9-yr. mean.	Mean.	Departure from 3-yr. mean.	Mean.	Departure from 7-yr. mean.	Mean.	Departure from 6-yr. mean.	Mean.	Departure from 6-yr. mean.
Surface	4.50	−1.62	2.88	−0.50	5.95	−0.96	1.83	−0.57	6.81	−2.22	3.41	−0.56
250	4.47	−1.60	.....	.....	5.91	−0.91	.....	.....	6.60	−2.09	3.35	−0.52
500	4.08	−1.31	2.84	−0.40	5.62	−0.56	1.81	−0.56	6.06	−2.00	2.82	−0.55
750	3.78	−1.09	2.74	−0.22	5.39	−0.38	1.71	−0.47	5.54	−1.88	2.56	−0.49
1,000	3.51	−0.88	2.63	−0.17	5.24	−0.20	1.79	−0.33	5.13	−1.57	2.34	−0.43
1,250	3.28	−0.70	2.49	−0.16	4.93	−0.07	1.82	−0.23	4.54	−1.53	2.07	−0.43
1,500	3.06	−0.49	2.37	−0.12	4.54	−0.02	1.76	−0.17	4.02	−1.49	1.95	−0.33
2,000	2.49	−0.40	2.09	−0.08	3.45	−0.17	1.58	−0.12	3.08	−1.37	1.95	+0.06
2,500	2.15	−0.26	1.69	−0.13	2.53	−0.31	1.34	−0.06	2.26	−1.39	1.46	−0.18
3,000	1.84	−0.19	1.35	−0.18	2.06	−0.27	1.08	−0.02	1.77	−1.20	1.24	−0.19
3,500	1.48	−0.25	0.93	−0.30	1.52	−0.43	0.68	−0.09	1.31	−1.13	1.13	−0.14
4,000	1.22	−0.18	0.62	−0.35	1.23	−0.42	0.46	−0.07	0.99	−0.98	.....	.....
4,500	1.00	−0.20	0.39	−0.37	.....	.....	0.32	−0.31	0.69	−0.97	.....	.....
5,000	0.91	−0.20	0.28	−0.26	.....	.....	0.17	−0.38	0.49	−0.91	.....	.....

TABLE 2.—*Free-air resultant winds (m. p. s.) during January, 1924.*

Altitude, m. s. l. (meters).	Broken Arrow, Okla. (233 meters).				Drexel, Nebr. (396 meters).				Due West, S. C. (217 meters).				Ellendale, N. Dak. (444 meters).				Groesbeck, Tex. (141 meters).				Royal Center, Ind. (225 meters).			
	Mean.		6-year mean.		Mean.		9-year mean.		Mean.		3-year mean.		Mean.		7-year mean.		Mean.		6-year mean.		Mean.		6-year mean.	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 12° W.	0.7	S. 32° W.	1.1	S. 69° W.	1.8	N. 89° W.	1.5	N. 50° W.	1.0	N. 76° W.	1.2	N. 66° W.	4.0	N. 58° W.	3.1	N. 10° W.	0.5	N. 34° W.	0.5	S. 57° W.	2.6	S. 52° W.	2.2
250	S. 12° W.	0.8	S. 29° W.	1.3	.....	.....	.....	.....	N. 51° W.	1.0	N. 79° W.	1.4	.....	.....	.....	.....	S. 60° W.	0.6	N. 74° W.	0.4	S. 52° W.	2.9	S. 51° W.	2.4
500	S. 24° W.	2.3	S. 26° W.	2.3	S. 84° W.	2.8	N. 83° W.	2.4	S. 64° W.	1.1	S. 86° W.	2.6	N. 71° W.	4.9	N. 61° W.	3.4	S. 38° W.	2.8	S. 52° W.	1.5	S. 54° W.	6.1	S. 59° W.	4.7
750	S. 44° W.	3.2	S. 34° W.	3.3	N. 86° W.	4.9	N. 77° W.	4.3	S. 58° W.	2.6	S. 83° W.	4.2	N. 64° W.	8.2	N. 64° W.	5.4	S. 51° W.	3.1	S. 60° W.	2.5	S. 60° W.	7.5	S. 66° W.	6.7
1,000	S. 55° W.	4.2	S. 48° W.	3.8	N. 82° W.	6.3	N. 76° W.	5.6	S. 65° W.	4.3	S. 82° W.	5.6	N. 56° W.	9.5	N. 62° W.	6.6	S. 63° W.	3.7	S. 62° W.	3.5	S. 65° W.	9.0	S. 75° W.	7.7
1,250	S. 82° W.	4.2	S. 66° W.	3.9	N. 79° W.	8.3	N. 75° W.	6.9	S. 71° W.	6.5	W.	7.5	N. 51° W.	10.5	N. 63° W.	7.6	S. 68° W.	5.1	S. 71° W.	4.7	S. 69° W.	12.2	S. 79° W.	9.3
1,500	W.	6.1	S. 66° W.	5.0	N. 79° W.	9.2	N. 74° W.	8.2	S. 70° W.	8.9	S. 85° W.	9.3	N. 55° W.	10.1	N. 64° W.	8.0	S. 82° W.	5.6	S. 76° W.	5.8	S. 70° W.	13.0	S. 82° W.	10.4
2,000	N. 86° W.	7.8	S. 78° W.	7.1	N. 76° W.	11.6	N. 73° W.	10.6	S. 73° W.	13.2	S. 89° W.	12.1	N. 56° W.	12.7	N. 64° W.	10.6	S. 85° W.	7.5	S. 79° W.	7.3	S. 69° W.	14.6	S. 82° W.	12.2
2,500	W.	8.3	S. 84° W.	8.4	N. 78° W.	13.3	N. 79° W.	12.8	S. 80° W.	16.4	N. 88° W.	15.2	N. 56° W.	14.4	N. 64° W.	12.7	S. 78° W.	9.8	S. 80° W.	8.6	S. 79° W.	14.8	S. 88° W.	14.3
3,000	N. 88° W.	8.5	N. 86° W.	9.7	N. 83° W.	13.4	N. 80° W.	14.2	S. 84° W.	16.8	S. 89° W.	16.6	N. 59° W.	15.8	N. 68° W.	14.2	S. 71° W.	11.4	S. 79° W.	10.1	S. 78° W.	14.4	S. 87° W.	14.2
3,500	N. 75° W.	10.2	N. 82° W.	10.4	N. 83° W.	16.3	N. 80° W.	15.4	S. 57° W.	14.2	S. 87° W.	15.7	N. 62° W.	14.6	N. 67° W.	15.1	S. 69° W.	14.2	S. 82° W.	11.2	S. 45° W.	15.3	S. 76° W.	13.2
4,000	N. 73° W.	12.0	N. 84° W.	13.4	N. 79° W.	18.5	N. 87° W.	17.0	S. 45° W.	15.6	N. 89° W.	15.0	N. 61° W.	15.7	N. 60° W.	16.6	S. 65° W.	14.0	S. 74° W.	12.4	S. 45° W.	18.1	S. 66° W.	17.3
4,500	S. 87° W.	8.7	S. 82° W.	10.5	N. 81° W.	17.1	N. 81° W.	17.3	.....	.....	.....	.....	N. 46° W.	20.6	N. 50° W.	19.4	S. 67° W.	17.3	S. 73° W.	14.2	.....	.....	.....	.....
5,000	N. 86° W.	9.0	N. 88° W.	11.9	N. 68° W.	16.6	N. 83° W.	16.6	.....	.....	.....	.....	.....	.....	.....	.....	S. 82° W.	16.5	S. 88° W.	15.2	.....	.....	.....	.....

THE WEATHER ELEMENTS.

By P. C. DAY, Meteorologist in Charge of Division.

PRESSURE AND WINDS.

January, 1924, will be remembered throughout much of the country as a month of rapid and well-marked variations in weather conditions. This was particularly noticeable in the great central valleys, where temperature changes especially were frequent and large, in fact at a number of points the average temperature variability was the greatest of record.

Anticyclones of a pronounced winter type moved from Canada into the United States at frequent intervals, pursued courses well to the southward, and brought severe cold to the Gulf and South Atlantic Coast States. The most important of these entered the far Northwest on the 4th with pressure readings, reduced to sea level, above 31 inches, and advanced into the central valleys by the morning of the 5th, and to the Gulf States during the following 24 hours. This high pressure area maintained its initial strength as it moved eastward and southward to a remarkable degree and gave the highest pressure readings ever recorded at numerous points in the southern Plains and Gulf States.

This anticyclone was attended by unusual cold over the Southern States from Texas eastward, approaching closely the temperatures experienced during the record-breaking cold wave of February, 1899, and caused immense damage in the fruit and vegetable growing regions along the Gulf and South Atlantic coasts, although the severe cold did not reach the important citrus and early vegetable districts of central and southern Florida, nor those of the lower Rio Grande Valley of Texas.

Other important anticyclones, attended by severe cold, moved southward and eastward from the Canadian Northwest about the end of the first decade, near the middle of the second decade, on the 20th to 21st, and again on the 25th and 26th.

At the beginning of the month an important cyclone, though attended mainly by only light rain or snow, was moving down the St. Lawrence Valley, and another was developing over the far Southwest. The latter moved eastward and, with another that appeared to have developed over the Great Lakes, gave extensive precipitation from the Mississippi Valley eastward, with heavy falls over the Ohio Valley and portions of the Gulf and Atlantic Coast States.

By the end of the first decade a cyclone of considerable proportions had developed over the middle Mississippi

Valley and its movement toward the northeast during the 10th and 11th was attended by precipitation over all eastern districts, and by gales along the North Atlantic coast. Precipitation was again heavy in the Ohio Valley and portions of the Gulf and Atlantic Coast States, and snow fell over most Northern States from the Dakotas eastward.

About the middle of the month cyclonic conditions developed in the Great Plains region and during the 16th and 17th precipitation overspread practically all central and eastern districts, heavy rains occurring over the Gulf and Atlantic Coast States, with more or less snow from the upper Mississippi Valley eastward.

The latter part of the month had less cyclonic activity, though an important disturbance moved from the lower Mississippi Valley northeastward to the Great Lakes and New England from the 24th to 26th, attended by important rains in the Atlantic coast districts, snows in the Great Lakes region and to the eastward, and high winds along the middle and north Atlantic coast.

The month as a whole was remarkably free from severe storms on the Pacific coast, a condition that has now persisted for several months.

The average pressure for the month conformed to the type usually associated with a cold month, although the mean values were universally materially higher than normal, and particularly so in the mountain districts of the West.

Compared with the means for the preceding December, those for January were higher in all districts by considerable amounts, though this is somewhat unusual, as under normal conditions January pressures are lower than those for December in most districts from the lower Mississippi Valley northeastward to New England, and from Texas northwestward to Oregon and southern Idaho.

The highest winds of the month were mainly along the north Atlantic coast, the maximum reported, 80 miles per hour, occurring at Atlantic City, N. J., on the 16th. On the north Pacific coast, where high winds are usually frequent at this period of the year, they were notably absent until near the end of the month.

In the region of the Great Lakes pressure variations were frequently large and wind movement was greatly augmented. At Buffalo, N. Y., the average wind velocity was the greatest of record for any month.

On account of the turbulent state of the atmosphere from the Rocky Mountains eastward the prevailing directions of the winds varied greatly, though they were mainly from northerly points in the Gulf and Atlantic Coast States, from the south in the Middle Plains, and from westerly points along the northern border. In the districts from the Rocky Mountains westward they were mainly outward from the high pressure area central over eastern Oregon, southern Idaho, and the northern portions of Utah and Nevada.

TEMPERATURE.

The outstanding feature of the temperature conditions existing during the month was the sharp change from unusual warmth that had prevailed during the two preceding months over much of the country to almost steady cold that set in near the close of the year and continued over the greater part of the month.

In the central valleys and the Northwest low temperatures persisted to such an extent that, but for the few days of unusual warmth at the end, the averages for the month would have equaled or approached closely those attained in January, 1918, one of the coldest months of record.

Save for the severe cold wave that visited the Southern States on the 5th and 6th, the temperatures were not abnormally low, but the periods of warmth, though frequent, were unusually short and the returns to cold were quick and sharp.

The more important cold periods were at or near the beginning of the month in the far Northwest, and over considerable portions of the Great Plains and Southwest; and on the 5th and 6th over most other districts, except that in the Northeastern States the lowest temperatures did not occur until near the end of the last decade.

The low temperatures in the Southern States on the 5th to 7th, as stated elsewhere, approached closely in many cases those of February, 1899, though fortunately the development of clouds with some rain over the southern and central portions of the Florida Peninsula hindered the advance of severe cold into those districts, and no serious damage resulted to the large citrus and early vegetable interests of those sections.

In addition to the immense damage to vegetation reported from the Gulf and South Atlantic coast sections, much loss was sustained from the severe cold throughout the South on account of frozen water pipes, automobile radiators, etc.

Over the Pacific coast States some unusually low temperatures occurred on the 2d and 3d, particularly in California, where damage to citrus interests appears to have been important. In the Northeastern States moderate temperatures continued, as during the preceding month, except for the last decade.

The lowest temperature reported during the month was 53° below zero, which occurred at a point in Montana on the 1st.

The highest temperatures for the month were mainly near the end, particularly from the Rocky Mountains and northern Great Plains westward. Elsewhere they varied greatly as to dates.

The averages for the month were below normal over the greater part of the country, the only exceptions being the Northeastern States and the immediate Atlantic coast districts as far south as Virginia, the southern portion of Florida, and small areas along and near the coasts of California, Oregon, and Washington. Over all interior districts the month was colder than normal, the departures ranging up to nearly 8°.

PRECIPITATION.

Considering the country in its entirety the month may be classed as one of largely deficient precipitation, the only States having amounts above the normal, as a whole, being those of the Atlantic and Gulf coasts, the Appalachian Mountain districts, and portions of the Great Lakes region. All other States had averages less than normal, although small areas in a few had normal or slightly larger amounts. In general precipitation east of the Mississippi Valley was well distributed through the month, sufficient for present needs, and in the southern and more eastern districts the falls were generous, some localities receiving up to 8 inches or slightly more.

Between the Great Plains and the Rocky Mountains there was little precipitation, and many large areas in this region had no measurable amounts. In the Plateau region there was little precipitation, particularly in the southern portions where at certain points clouds were entirely absent and sunshine was 100 per cent of the

possible, the greatest of record for January. Over the Pacific coast sections the precipitation was practically everywhere less than normal, the deficiencies being large in California, where similar conditions have persisted for several months.

SNOWFALL.

In nearly all sections of the country the snowfall for January was less than normal, although considerable areas had a slight covering during much of the month. In the districts east of the Rocky Mountains the greatest depths were reported from northern New York, the interior of New England, and over the upper Lake region, but no particularly heavy falls occurred during the month. In general, not much interference to business interests resulted from drifting snow, save in Iowa and portions of adjoining States, where traffic was interrupted following the storm of the 8th and 9th and again about the 15th.

In the western Mountain districts the snowfall during January was likewise less than normal, though in portions of the middle Rocky Mountains there were more generous amounts.

In California and the adjacent portions of Oregon and Nevada the snowfall was unusually light, and in some sections probably the lightest of record for January.

The stored amounts in the higher mountains at the end of the month, where great importance attaches to the probable supply of water for irrigation and power purposes, are nearly everywhere less than normal.

Over the northern districts from the Great Lakes westward ice of sufficient thickness to harvest formed early in the month, and its storage progressed satisfactorily, through the month. In the more eastern districts, however, where ice is gathered for commercial purposes, it did not acquire a satisfactory thickness until late in the month.

RELATIVE HUMIDITY.

Despite the absence of appreciable precipitation over the Great Plains and mountain districts of the West, the relative humidity in these regions was mainly above normal. Over the Pacific coast States, however, particularly in California, the drought conditions were reflected in the lowered percentage of the relative humidity, which was in some cases nearly 20 per cent less than normal. On the other hand over the Atlantic and Gulf coast States, despite the fact that precipitation was generous to heavy, the relative humidity was also less than normal.

SEVERE LOCAL STORMS, JANUARY, 1924.

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the annual report of the Chief of Bureau.]

Place.	Date.	Time.	Width of path, yards.	Loss of life.	Value of property destroyed.	Character of storm.	Remarks.	Authority.
Brooklyn, N. Y.	1					Wind	A number of houses in course of construction were wrecked.	Daily News (New York).
Meridian, Miss. (4 miles southwest of).	3	1-2 a. m.				Tornado	Four homes wrecked and a store damaged; 1 person injured.	Official, U. S. Weather Bureau.
Rome, Ga.	10	P. m.				Wind	Considerable property damaged and 2 persons injured.	Star (Anniston, Ala.).
Central and northeastern Alabama.	10	do.		2		do.	Several dwellings damaged and a number of barns and sheds wrecked; some livestock killed; several persons injured.	Do. Pensacola News (Fla).
New York, N. Y., and vicinity.	16-17			6		High winds	General damage done; many persons injured.	Official, U. S. Weather Bureau.

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STORMS AND WEATHER WARNINGS.

By EDWARD H. BOWIE, Supervising Forecaster.

WASHINGTON FORECAST DISTRICT.

The month of January was notable for the frequency and pronounced character of its temperature changes, and this was particularly true of the Middle West and the Northwest, where a number of pronounced cold waves, that came southward out of Canada, reduced the temperatures for the month greatly below the normal. While these cold waves in several instances advanced eastward to the Atlantic coast and southward to the Gulf of Mexico, they were greatly modified in severity, and consequently no record-breaking low temperatures occurred except over limited areas. The eastward passage of high and low pressure areas occurred with great frequency, and as a result there were marked changes from high to low temperature and frequent changes from fair to falling weather. Moreover, the issue of storm warnings for the coastal waters was rather more than is ordinarily required for the month of January. The notable storm of the month occurred on the 16th, when southerly gales broke the airship *Shenandoah* from its mooring mast at Lakehurst, N. J.; and it was only because of a lull in the wind shortly thereafter was her crew able to bring her back to her hangar at Lakehurst. At noon of the day in question the Bureau of Aeronautics of the United States Navy Department was advised that the wind at Lakehurst would likely reach a velocity of 60 miles an hour or more during the late afternoon and early night.

The month opened with high barometric pressure general east of the Rocky Mountains, but with a low-pressure area of increasing intensity over the western Plateau region. This disturbance lost intensity in moving southeastward during the night of the 1st, but on the morning of the 2d there were unmistakable evidences of the formation of a center of low pressure over the northwestern portion of the Gulf of Mexico. This disturbance developed, as foreseen, and advanced northeastward and produced general precipitation over and east of the Mississippi Valley during the succeeding 36 hours. This was in turn followed by an area of high barometric pressure of great magnitude which on the morning of the 3d had its crest over the Northwestern States, and made necessary the issue of cold-wave warnings for practically all parts of the Washington Forecast District. These warnings were issued on the 3d, 4th, and 5th as the cold wave advanced eastward. On the 5th, as this high pressure was advancing eastward and the pressure falling rapidly off the Atlantic coast, storm